

Statement of Michael J. Armstrong
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before the Subcommittee on Science, Technology, and Space
of the Senate Committee on Commerce, Science, and Transportation
United States Senate

Mr. Chairman and Members of the subcommittee, I am Michael J. Armstrong, Associate Director for Mitigation of the Federal Emergency Management Agency (FEMA). I am joined by Craig S. Wingo, who was recently named as the Director of the National Earthquake Programs Office and several staff members. It is a pleasure to be with you today to discuss the earthquake hazards reduction activities of the federal government.

Earthquakes represent the largest single potential for casualties and damage from a natural hazard facing this country. They represent a national threat, as all but seven states in the U.S. are at some level of risk. In our most recent earthquake disaster, Northridge, a moderate earthquake centered on the fringe of a major metropolitan area caused an estimated \$40 billion in damage. Exactly one year later, the Kobe, Japan earthquake demonstrated the impact of a larger event directly under a major metropolitan area that bears a striking resemblance to Oakland, California. A large magnitude earthquake located under one of several urban regions in the United States could cause thousands of casualties and losses approaching \$200 billion. Accordingly, reducing earthquake losses is a matter of national concern.

Recent findings show a significantly increased potential for damaging earthquakes in southern California, and in northern California on the Hayward fault. Studies also show higher potential of earthquakes for the Pacific Northwest and coastal South Carolina. This is in addition to areas of earthquake risk that have already been identified, such as the New Madrid fault zone in the central U.S. and Wasatch front in Utah. The earthquake risk that our nation risk faces can be reduced, and this responsibility is shared by federal, state, and local governments and the private sector.

The National Earthquake Hazards Reduction Program, or NEHRP, is the Federal Government's coordinated approach to addressing earthquake risks. NEHRP involves the closely coordinated efforts of four Federal agencies - FEMA, the United States Geological Survey (USGS), the National Science Foundation (NSF), and the National

Institute of Standards and Technology (NIST). The premise of the Program is that while earthquakes may be inevitable, earthquake disasters are not. NEHRP activities include basic and applied research, technology development and transfer, and training, education and advocacy for seismic risk reduction measures. In these activities the NEHRP agencies work collaboratively with each other, and with other federal and state agencies, private companies, universities, regional, voluntary and professional organizations.

Our basic authority is the Earthquake Hazards Reduction Act of 1977, the purpose of which is "...to reduce risks of life and property from future earthquakes in the United States through the establishment and maintenance of an effective earthquake hazards reduction program." The Act's aims include improved understanding, characterization and forecasting of seismic hazards and vulnerabilities; improved model building codes and land use practices; development and improvement of seismic design and construction techniques; accelerated application of research results; and reduced risk through the use of post-earthquake investigations and education.

FEMA has two roles within NEHRP. First, we serve as lead agency for the program. This role involves program coordination, both within the federal government and with external constituencies, the preparation of a consolidated program budget document and a multi-year plan, and periodic reports to the Congress. Second, FEMA works to translate the results of research and technology development into effective earthquake loss reduction measures at state and local levels of government. In this role, we administer a program of grants and technical assistance to states and multi-state consortia designed to increase awareness of the earthquake hazard and to foster plans and actions to reduce seismic vulnerability. We support the development and dissemination of improved seismic design and construction techniques for new buildings and retrofit guidelines for existing buildings. This material is made available to federal, state and local entities for voluntary use through model building codes and standards organizations and design professionals. FEMA also develops and supports public education and awareness programs on earthquake loss reduction.

I am particularly pleased to be here today to report on the status of a number of activities that FEMA and the other NEHRP agencies have been working on since we last appeared before this Committee in April 1997, and more importantly, how we have set the stage for even more significant activities in the near future.

Director Witt has made mitigation a priority for FEMA. He has done this by implementing programs and initiatives that will alter the traditional approaches to disaster management by addressing risks before disasters rather than after, something that I will come back to later. At the same time, FEMA has worked to develop goals and

objectives to meet the requirements of the Government Performance and Review Act (GPRA). Both of these factors have assisted the Program Office in its work with the NEHRP agencies in developing a NEHRP Strategic Plan.

Since we last reported to you, a considerable amount of work has gone into development of the Plan. The four NEHRP agencies have worked very closely throughout the planning process, and I can say that I was pleased with the collegial approach that characterized the process. With completion of the first draft, it was presented to almost 50 representatives of the earthquake community at a workshop held in the fall of 1997. Based on the comments we received, the Plan was significantly modified and sent back out to the same reviewers. Comments we received back on this second review were far more favorable, and we now believe we have a workable plan for the program.

The Plan, entitled *Using Knowledge to Reduce Earthquake Losses*, is progressing, with an Implementation Annex to be developed with input from a constituent workshop to be held this September. FEMA intends to consult closely with the Committee.

FEMA's other lead agency responsibility that I want to briefly touch on is our requirement to present to you a report on program activities for fiscal years 1997 and 1998. While it has always been problematic to collect the data from four different agencies, draft the report, receive agency and OMB approval and publish the final report within the first quarter window, I am pleased to be able to present to you the completed NEHRP Biennial Report. As you review the report, you will notice that it is shorter than previous versions. Our goal was to condense the report into a more corporate-like format that focuses on examples of activities of the four agencies that met the goals of the Strategic Plan and the program. We believe it is more readable and, ultimately, more useable to our customers.

In specifically referencing FEMA's program activities, I would first like to touch on our fiscal year 2000 budget to give you an overall framework of our activities and level of resources we are planning to devote to each. Using the Program Elements specified in the Act, our allocations are as follows:

- Planning for and Mitigating Earthquakes, which includes state grants, building science activities, lifelines, HAZUS, planning, outreach, and pre-disaster mitigation activities
 - FY99: \$11,054,000 and 35 FTE
 - FY00: \$10,385,000 and 35 FTE
- Information Systems and Dissemination, which includes training, education and awareness activities

FY99: \$861,000 and 4 FTE

FY00: \$385,000 and 5 FTE

- Lead Agency, which includes NEHRP support activities
FY99: \$375,000 and 4 FTE
FY00: \$450,000 and 5 FTE
- International Cooperation, which consists of U.S./Japan activities
FY99: \$70,000 and no FTE
FY00: \$50,000 and no FTE

Since our last appearance before this Committee, FEMA believes it has made some significant contributions towards the program's goals.

New Buildings: Our first step toward reducing losses from earthquakes has been to improve the design and construction of new buildings. To accomplish this, FEMA has supported the development and triennial updating of the *NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures*, by the Building Seismic Safety Council. The *NEHRP Provisions* present criteria for design and construction of buildings subject to earthquakes anywhere in the United States, and is widely used by practicing design professionals and building officials. This resource document has either been adopted by or influenced changes to all three of the nation's model building codes.

The latest version, the 1997 edition, is significant in that it now includes new seismic design maps and design procedures based on the recently developed USGS seismic hazard maps. Other significant changes include improved material for near-fault high seismic areas, updated chapters such as the steel design chapter to take into account lessons learned from the Northridge earthquake, and a new chapter on non-building structures (including those used in some types of lifelines). In generating the 1997 edition, we worked closely with the Structural Engineers Association of California, who develop the seismic material used in the Uniform Building Code, to reconcile differences between the two documents. We have already begun the 2000 update of the *NEHRP Provisions* and this work will include several improvements, including development of a simplified design procedure for non-engineered buildings.

Building Codes: The three model building codes used throughout the country recently agreed to develop a single set of coordinated codes, including the *International Building Code (IBC)* and the *International Residential Code (IRC)*, in order to improve code compliance, code adoption, education and certification throughout the country. Adequately addressing the seismic hazard was one of the more significant challenges in developing a single code since current seismic provisions use two different sources. To resolve this issue, the International Code Council determined that the 1997 *NEHRP*

Provisions, including the new seismic design maps, would be the best basis for the seismic provisions of the new codes. As part of this agreement, FEMA funded a Code Resource Development Committee to convert the *NEHRP Provisions* into code language using a process that involved participation and input from all interested parties. That material has been incorporated into the *IBC* and *IRC*, and those codes are currently going through their final public hearing process, which will culminate with a final ballot at the first joint code conference in September 1999 and publication of the codes in April 2000. The use of the *NEHRP Provisions* in the *IBC* and *IRC* will serve to improve the seismic resistance of the countless buildings constructed in our nation from this point forward.

Existing Buildings – Rehabilitation Guidelines: In September of 1997, we achieved another major milestone in the FEMA program to increase the seismic resistance of existing buildings. We completed the *NEHRP Guidelines for the Seismic Rehabilitation of Buildings* and related *Commentary*, the culmination of a 5-year \$7.7 million effort performed for FEMA by the Building Seismic Safety Council, which represents a broad spectrum of the engineering and construction industries. For the first time in this country, building owners, design professionals and construction practitioners now have at their disposal nationally applicable technical criteria covering all building types and building materials. These users are now able to choose design approaches consistent with different levels of seismic safety as dictated by location, seismic safety performance objective, building type, occupancy, availability of resources, or other relevant considerations. Combined with new analytical techniques, these criteria yield estimates of the seismic performance of a higher order of reliability than has previously been possible. The *Guidelines* are the first of a series of performance-based resource documents planned for the coming decade. Already most of the prestigious design firms all over the country are applying the *Guidelines* in their day-to-day activities. Demand has been such that a second 5,000-copy printing has already been done.

Two publications to complement the *Guidelines* were also part of the original planning. The first, published in March 1998, is aimed primarily at decision-makers and explores the societal implications to localities undertaking extensive seismic rehabilitation programs or projects, either voluntarily or through mandating. The second is in final editing and is directed to engineers, architects, and building regulatory personnel. It provides users with detailed examples of how to apply the *Guidelines* to each of the major building types, identifying most common seismic deficiencies, suggesting solutions, and providing typical costs.

We are taking additional steps to encourage the application of the new knowledge generated by the *Guidelines* by intended users. As is often the case with new advances in any field, potential users need to be convinced that the new information yields rational

results, is not too difficult to apply, and is not too restrictive. The seismic engineering community is no exception. To respond to these normal reactions, we undertook the seismic design of 41 buildings, some located in "Project Impact" communities receiving FEMA pre-disaster mitigation grants, using the *Guidelines*. The majority of these buildings were taken from the Federal owned-buildings inventory prepared in response to Executive Order 12941. They had all been evaluated and their deficiencies identified. Carefully selected engineering firms were asked to prepare designs based on the criteria and procedures contained in the *Guidelines* and respond to a number of queries. The designs have been completed and the analysis phase of the project is underway. Results are expected by the end of September 1999 and will be widely publicized.

We have also undertaken other steps to disseminate the technology contained within the *Guidelines*. A two-day modular seminar has been prepared and will be given in a total of 19 cities, some of which are Project Impact communities. So far the seminars have been well attended (in Los Angeles, a second seminar had to be scheduled because the first one was overbooked). The seminar material will soon be available on tapes that FEMA will distribute upon request. The *Guidelines* and *Commentary* have recently also been posted on the Internet, where they can be downloaded by users.

The ultimate goal that we have is for the *Guidelines* to become a standard approved by the American National Standards Institute (ANSI), so that it can be referenced in model codes, ordinances, and contracts, and thus become more conveniently part of the mainstream of seismic engineering activities. As a necessary first step in this process, we have asked the American Society of Civil Engineering (ASCE) to convert them into mandatory language (a "pre-standard"), while preserving the fundamental philosophy, approaches, analytical techniques, and acceptance criteria embedded in the *Guidelines*. The effort is well underway and is to be completed by June 2000. The pre-standard will reflect the results of the analysis of the 41-buildings project and the Steel Moment Frame Buildings project discussed below, and information gathered from users in several venues by various mechanisms, including a users' forum. It will be published by FEMA, but also made available to the ASCE Standards Committee for their balloting and eventual approval as an ANSI-approved standard.

Existing Buildings – Seismic Evaluation Handbook: We also completed on schedule and budget another effort mentioned in our testimony before this Committee two years ago, an updated and enlarged handbook for the seismic evaluation of buildings. It builds on an earlier version that had become a *de facto* standard in this field, but reflects advances in technology and lessons learned in earthquakes in the past ten years, is consistent with the *Guidelines*, and covers higher-than-life-safety levels in a three-tier analytical approach. This pre-standard has been published and is being very widely used. It was also made available to the same ASCE Standards Committee mentioned

above and is undergoing the prescribed approval process prior to becoming an ANSI-approved standard in the near future.

To replace a 1985 plan on the seismic safety of existing buildings that had served us very well as a “roadmap”, but had run its course, we asked the Earthquake Engineering Research Institute to prepare a new one. The new plan was completed and published in August 1998 as *Seismic Rehabilitation of Buildings: Strategic Plan 2005*. Prepared by a broad cross-section of our multi-disciplinary constituents, it contains many very thoughtful recommendations that we plan to adapt and implement as the Congress makes resources available to this Program.

Steel Moment Frame Buildings: One of the critical lessons of the January 17, 1994 Northridge earthquake was the brittle fractures of the beam to column connections in welded steel moment-resisting frame buildings. While no casualties or collapses occurred, a wide range of brittle connection damage has been found in almost 200 buildings, although the number of buildings suffering severe damage was far less. The effect of this damage was a loss of confidence in the codes and design procedures and a concern that these structures may not be safe. Because of this, FEMA quickly initiated a high priority, coordinated, problem-focused program of research and investigation to develop and validate reliable and cost-effective seismic-resistant design procedures.

The project consisted of a two-phase approach. The primary product of Phase 1 was the *Interim Guidelines* and to date FEMA has distributed close to 20,000 copies. This document and its recommendations, along with work done by NSF and NIST, established the *de facto* standard that has been in use since that time. In addition, it has been referenced in ordinances throughout California. Funding for Phase 1 was \$2 million from FEMA’s portion of the NEHRP Northridge Research Supplemental fund.

The goal of Phase 2 is to research, develop and verify reliable and cost-effective seismic design criteria for steel frame structures. This design criteria is for use by various building codes and standards, and will address the design of new steel moment frame buildings and the repair and upgrading of existing construction. Funding for Phase 2 consists of about \$6 million from the President's Northridge Earthquake Emergency Fund and \$3 million of FEMA earthquake program funds.

Work is either complete or well underway on all of the primary tasks, including assessing our current knowledge of steel building performance, conducting topical investigations, developing a series of state of the art reports, conducting a comprehensive testing program, developing an inspection program, assessing the economic, social and political impacts, and writing the final series of documents that will

provide design criteria. The contractor has recently prepared the 50% draft of these documents and a 50% workshop is scheduled for the end of this month. The guidelines are to be completed by early 2000. While four years may seem like a long time, that needs to be balanced against the fact that we are attempting to redo what originally took several decades. Much of the material that has resulted from this project is already finding its way into codes and standards, including the 1997 edition of the *NEHRP Recommended Provisions*, the American Institute for Steel Construction industry standard and common practice.

Wood Frame Construction: The seismic performance of wood frame residential structures has always been of concern to FEMA. While each individual house may not represent a significant financial threat, the sheer number of homes that make up this class of structure makes it one of the largest in terms of loss potential. It was for this reason that FEMA recently completed an update of its guidance document *Home Builder's Guide to Seismic Resistant Construction*.

In the investigation of damage from the Northridge earthquake, one of the more significant observations was the generally poor performance of wood-frame residential structures. This was especially true for larger multi-family shear wall structures, such as the Northridge Meadows complex, and for irregular structures, such as those built on hillside foundations or over garages. However, even regular single-family structures performed worse than expected and often suffered significant non-structural damage. Insurance and other loss data from Northridge has shown that roughly three fourths of all losses were to this class of structure. This does not include the cost of temporary housing, an issue that impacts FEMA directly.

Our original intent was to organize a comprehensive program similar to, although much smaller in scale than, the current Steel Moment Frame Buildings Program. In 1998, FEMA worked with the State of California to fund a \$5.2 million Hazard Mitigation Grant Program Award to the California Institute of Technology to study and develop economical methods of improving woodframe building performance in earthquakes. The Caltech-CUREe (California Universities for Research in Earthquake Engineering) project, funded using Stafford Act Section 404 monies, will involve both industry and academia, and will focus on applying results of project research into design materials usable for building codes. We believe that some very useful material will result from this project, and we will work to integrate that material into the *NEHRP Provisions* and into the model codes.

Lifelines: Since our last appearance before this subcommittee, FEMA has assumed the responsibility for issues involving lifelines. At that last appearance, FEMA and NIST had just completed and submitted at the Committee's request the *Plan for Developing and*

Adopting Seismic Design Guidelines and Standards for Lifelines. Since then, FEMA has entered into a cooperative agreement with ASCE to form the American Lifelines Alliance in order to implement the plan. This group will serve to stimulate a public-private partnership to reduce lifeline risks from earthquakes and related natural hazards. The first organization meeting was held in October 1998, and plans are underway to hold an Industry Workshop this summer. The Workshop will identify the technical guidance needed by lifeline stakeholders throughout the United States needed to achieve acceptable performance standards for earthquakes, and the criteria that should be used to prioritize the development of these guidelines.

Performance-Based Design: The building codes referenced earlier are all based on a life safety standard, the goal of which is to prevent loss of life by preventing collapse of the building. This design level is clearly not adequate for such structures as hospitals, fire stations, emergency command facilities, and other buildings that the owner would like to have functional immediately after an earthquake. Currently, there are several independent efforts underway to address this issue. FEMA funded the Earthquake Engineering Research Institute (EERI) to develop an Action Plan that would increase coordination in the field and which could possibly be used to support development of acceptable seismic performance based criteria for both new and existing buildings.

HAZUS: Any mitigation action must first begin with an accurate assessment of the seismic risk faced by a community or state. To accomplish this, several years ago FEMA began funding the development of HAZUS (Hazards US), a standardized disaster loss estimation model, currently with earthquake as the prototype application, developed by the National Institute of Building Sciences under contract to FEMA. HAZUS is the first nationally applicable methodology that can be used to determine and graphically display losses that could occur as the result of a given earthquake. The software includes modeling capability and an extensive inventory of GIS-located infrastructure, and has enabled users to determine the degree to which losses could be reduced as a result of mitigation actions. Emergency managers are now using HAZUS as a planning tool to predict the impact of an earthquake in their area. HAZUS can also be used in the immediate aftermath of an earthquake as a means to quickly estimate areas of severe damage. Finally, it offers the prospect of providing both a baseline and future measurement of seismic risk in the context of GPRA.

HAZUS was released to the public, including States, local communities and other Federal agencies in the spring of 1997. Since then, FEMA has funded a number of improvements to the methodology. FEMA intends to continue maintaining and enhancing the methodology to insure that it remains state-of-the-art. In March 1999, FEMA will release the next version of HAZUS that includes several technical and scientific enhancements that refine analytic capability and expanded functions for

response and recovery. FEMA is also currently working to develop loss estimation modules for flood and hurricane hazards that will eventually be incorporated within HAZUS, thereby expanding it to be a multi-hazard loss estimation tool.

In the last two years, all of the States and Territories have received training in the use of HAZUS. FEMA, through its Emergency Management Institute, is providing training to Federal, state and local communities, including many Project Impact communities. In all, more than 400 individuals have received HAZUS training and over 600 copies of HAZUS have been distributed free-of-charge to users representing all levels of government, the private sector, academic institutions and the international community. To promote the use of HAZUS, FEMA provides technical support to a growing number of HAZUS user-groups by participation in workshops, on-site training and technical assistance activities through the FEMA regional offices, earthquake consortia and local and State agencies and their private partners.

FEMA is also using HAZUS to conduct an Earthquake Average Annual Loss Study. HAZUS contains a uniform methodology and nationally consistent data base to allow for computing seismic risk across multiple regions throughout the United States. The study concentrates on losses to the general building stock and presents the results on an annualized basis. The study uses new measures to compare seismic risk at both the national and local level and to identify high-risk areas throughout the country. This type of quantitative and objective information will help decision-makers develop seismic risk management policies at the national level. The study also lays the groundwork to evaluate the benefits of earthquake mitigation strategies in an annualized basis.

State Support: One of the most important actions undertaken by FEMA is its continued support of earthquake risk reduction activities by State and multi-State organizations. The FY 1999 budget contains a total of just over \$5 million - approximately one-third of FEMA's earthquake program budget total – for state grants and technical assistance. Of this amount, \$4.4 million is distributed as grants among all 43 participating states and territories identified by the USGS as having a moderate or greater seismic hazard. The remainder is divided between support to multi-state organizations and the provision of ad hoc technical assistance in the form of short-term architectural and engineering support to states and localities. In Fiscal Year 2000 the State grants will be consolidated into the Emergency Management Performance Grant – the combining of seven non-disaster State grant programs. FEMA has for several years emphasized multi-hazard preparedness and mitigation programs based on risks identified by the States. This consolidation makes it easier for States to pursue multi-hazard initiatives such as hazard identification and risk assessment, mitigation planning, and promoting effective mitigation programs among communities.

Executive Orders: At the national level, FEMA continues its oversight of implementation of the two earthquake Executive Orders dealing with new buildings leased, assisted or regulated by the Federal Government and with existing buildings owned or leased by the Federal Government - numbers 12699 and 12941, respectively. Technical guidance for implementing these Orders is provided through the Interagency Committee on Seismic Safety in Construction (ICSSC) which is chaired by and receives technical secretariat support from NIST. Concerning new construction, all affected agencies have issued the procedures or regulations required to implement Executive Order 12699.

Concerning Executive Order 12941 on the seismic safety of existing Federal buildings, Section 8 of the 1990 Reauthorization Act (P.L. 101-614) requires that the President issue standards for the seismic safety of existing Federal owned or leased buildings by December 1, 1994. The President fulfilled that requirement by issuing Executive Order 12941 on schedule. In addition to the promulgation of seismic standards, the Order also requested that all Agencies in the Executive Branch conduct an inventory of these two categories of buildings and estimate the cost of rehabilitating those that need it by December 1, 1998. The Order further required that, based on these data and information, FEMA prepare and submit to the Congress by December 1, 2000 an economically feasible plan for ensuring the safety of Federal employees and their customers in case of an earthquake. I am pleased to report that the Agencies' inventories are being incorporated into a comprehensive database for FEMA by the Engineering Construction Research Laboratories of the Corps of Engineers, Department of the Army, and a multidisciplinary team of consultants is being assembled to prepare the required report. I want to assure you that the due date will be met.

This same report will also respond to the other mandate contained in the same Section of P.L. 101-614, namely a recommendation as to how to apply seismic standards to Federal buildings that are structurally regulated and financially assisted. FEMA obtained the services of the prestigious National Academy of Public Administration to examine the question and provide recommendations. These have been received and reviewed by all affected Agencies. They will be incorporated into the December 2000 report, thus providing to the Congress a comprehensive approach to a long-term solution for the seismic safety of all categories of Federal buildings.

International Activities: In 1996 and 1997, the United States participated with Japan in two U.S.-Japan Earthquake Policy Symposia. These symposia grew out of discussions between the President and the Prime Minister of Japan shortly after the Kobe earthquake, and they succeeded in bringing together officials from both nations to examine several policy issues. The participants, led by the Director of FEMA and the Minister of Japan's National Land Agency (NLA) in Japan, agreed to establish a "U.S.-Japan High-Level Forum for Earthquake Emergency Management Policy

Cooperation," co-chaired by FEMA and NLA. The goal of the forums was to continue the dialog on earthquake hazard reduction policies beyond the first two symposia. The first of the High Level Forums was held in Seattle, Washington in the fall of 1998, and the second is scheduled to be held in Japan in the fall of 1999. Each of the NEHRP agencies participated in the forum and is represented on the interagency group that is working with its counterpart group from Japan to plan the second forum.

Other NEHRP Agency Activities: While you will hear more from the other NEHRP agencies on their accomplishments, I would like to highlight a few that hold great potential for the future. NSF's selection of the three Earthquake Engineering Research Centers will benefit our state and regional partners by making these technical resources more accessible at the regional level. The new NSF Network for Earthquake Engineering Simulation (NEES), which is in the process of being funded under their Major Research Equipment (MRE) program, will result in significant improvements to the physical testing infrastructure and establish a network to allow testing and monitoring over the internet. This will provide new research resources while honoring the September 1995 EERI report, *Assessment of Earthquake Engineering Research and Testing Capabilities in the United States*. From the USGS, I would highlight the development of the new seismic hazard maps, from which USGS also assisted in developing into seismic design maps that are included in three FEMA documents. From NIST, I would highlight their new publication on retrofitting existing steel moment buildings, which is being done in cooperation with our Steel Moment Frame Buildings Project and the industry. These and other NEHRP agency activities demonstrate the growing success of the program, and the impact that we are having across the country.

Building on these achievements from all of the NEHRP agencies, I would like to present our vision for the future of the NEHRP. As lead agency, it is FEMA's goal to have the NEHRP focus on supporting loss reduction activities that save lives and property. To further that goal, FEMA, in concert with the other NEHRP agencies, has developed a NEHRP Strategic Plan, *Using Knowledge to Reduce Earthquake Losses*. That plan establishes a vision for NEHRP and the future of seismic safety in this country:

"The NEHRP agencies strive for a future in which all seismically vulnerable regions of the United States have practices and policies that minimize earthquake impacts on the private and public sectors."

To achieve that vision, the Strategic Plan spells out four goals:

- A. Accelerate implementation of earthquake loss-reduction practices and policies.
Promote earthquake loss reduction activities and support those who adopt, implement, and enforce such policies and practices.
- B. Improve techniques to reduce seismic vulnerability of facilities and systems.
Develop, improve, and disseminate products that guide design and construction

practices and land-use planning, and improve professional practice.

- B. Improve the quality and use of seismic hazard identification and risk-assessment methods. *Develop, improve, and disseminate products that portray earthquake-related hazards accurately and quantify seismic risk.*
- C. Improve the understanding of earthquakes and their effects. *Support research to understand the processes that lead to earthquakes and associated hazards and to advance engineering, social, and economic knowledge.*

A.

The goals are deliberately ordered, beginning with the most important, reducing losses, and followed by successive goals, each of which provide a basis for the previous, ending with a solid foundation of basic and applied research.

- B. With the gradual transition of importance to the first goal, we believe that the NEHRP will need to evolve to shift the program's emphasis from primarily research into implementation of research results toward improved earthquake loss reduction measures. Research will always need to remain an important part of the NEHRP. However, our knowledge has now reached the point where we need to be able to effectively implement the results of this work to reduce earthquake losses at the federal, state and local levels. It seems appropriate to modify the NEHRP authorization language to assist in this evolution.

- C. This change in priority seemed to be the intent of Congress when several representatives wrote to the President in November 1993 expressing their concerns regarding the NEHRP. That letter provided the basis for the Office of Science and Technology Policy (OSTP) report on the Administration's review of the NEHRP. That April 1996 document, entitled *Strategy for National Earthquake Loss Reduction*, called for the formation of a National Earthquake Loss Reduction Program (NEP). FEMA was designated the lead agency for that effort, and responded by establishing a National Earthquake Programs Office to support lead agency functions for both NEHRP and NEP.

- D. The program goals articulated in the OSTP report were notable in their focus on the implementing research results to improve mitigation:

- * Provide leadership and coordination for Federal earthquake research;
- * Improve technology transfer and outreach;
- * Improve engineering of the built environment;
- * Improve data for construction standards and codes;
- * Continue the development of seismic hazards and risk assessment tools;
- * Analyze seismic hazard mitigation incentives;
- * Develop understanding of societal impacts and responses related to earthquake hazard mitigation;

- * Analyze the medical and public health consequences of earthquakes; and
- * Continue documentation of earthquakes and their effects.
- *

* These goals served as a basis for the development of the four NEHRP Strategic Plan goals stated above, and it is those four goals that will serve as the framework for the agencies' future program activities as articulated in the Strategic Plan.

* The OSTP report was also significant in that it recommended that the core NEHRP agencies be supplemented by additional Federal agencies that were involved in earthquake loss reduction activities. These agencies include:

- DOD, especially Army Corps of Engineers, which conducts seismic research at several of its laboratories;
- DOE, which has developed seismic regulations for its nuclear and conventional power plants;
- DOT, which is responsible for seismic regulations for the nation's bridges and highways;
- EPA, which is responsible for control of hazardous materials, a serious problem during an earthquake;
- GSA, which sets standards for federal construction;
- VA, which sets its own higher standards for hospital construction.
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- There are other agencies that also have construction projects in seismic areas, and they also have a vital concern with improved construction practices for new and existing buildings. Most of these agencies are already represented on the Interagency Committee for Seismic Safety in Construction (ICSSC).
- The current NEHRP authorizing language includes language referencing other agencies. Specifically, Section 7704(b)(E) of the Act states that the lead agency shall "request the assistance of Federal agencies other than the Program agencies as necessary to assist in carrying out this chapter." We believe that it would significantly strengthen the NEHRP if selected other Federal agencies were able to more formally interact with the NEHRP Program agencies under the umbrella of the program. Such an established relationship would serve to:
 - A. improve coordination between all relevant Federal agencies and their programs;
 - B. better identify gaps where the Federal government should be taking a larger role; and
 - C. provide a level of legitimacy to the respective earthquake-related work of their agency.
- A.
- B. The final area I would like to cover is the future direction of the NEHRP and earthquake loss reduction. The NEHRP Strategic Plan captures a sense of this

future direction by providing a list of what the agencies have termed “areas of emphasis.” These are areas where two or more agencies feel there is a need and an opportunity for a collaborative effort, and where the agencies intend to devote future resources. These areas include:

- ◆ Emphasize regional and community-based approaches to loss reduction, such as Project Impact.
 - ◆ Promote the use of hazard identification and risk assessment as a tool for mitigation planning.
 - ◆ Improve the assessment and mitigation of earthquake effects on buildings, utilities, and transportation systems.
 - ◆ Determine the costs and benefits of alternative mitigation strategies.
 - ◆ Promote improvements in professional practices.
 - ◆ Improve the accuracy, completeness, availability, and timeliness of information about earthquakes and earthquake damage.
 - ◆ Improve the experimental research infrastructure.
- ◆
- ◆ Within the framework established by the four NEHRP Strategic Plan goals, these areas of emphasis provide an outline of those subjects the four NEHRP agencies feel should be the focus of their combined efforts over the next two years and beyond. These areas capture the sense of direction in which we all believe the program should be heading. This listing will be updated as the Strategic Plan is updated.
- ◆ Our vision of where the program should be heading can be best be summarized by encouraging the evolution of earthquake mitigation from an environment of “technology-push” to one of “demand-pull.” Although there are exceptions, until now our scientific and engineering research and development activities have generally resulted in a sophisticated suite of risk reduction policies and technologies that we have been urging upon decision-makers who have had little incentive to adopt and enforce them. It is our vision that earthquake mitigation would eventually become something that is pulled along by public demand.

The NEHRP has been extremely successful in developing an impressive array of products that can be used by an individual or community who wants to reduce their earthquake risk. This “mitigation toolbox” has been used very effectively by engineers, architects and building regulators when they have been allowed to address the hazard. The problem has been that there has been little public demand to provide the time and resources necessary to reduce the risk. Instead, public perception is that the building to

code will result in a structure that won't be damaged and, if it is, the Federal will come to the rescue and make them whole again. Both are false. The building codes only provide a minimum level necessary to protect life safety, and do little to prevent damage, and, as you well know, Federal disaster assistance was never meant to be a synonym for insurance.

- ◆ An excellent example of this evolution is the automotive industry. Ten years ago, there was great resistance to the installation of air bags and the public generally appeared to be apathetic towards the issue of safety. Today, the public considers the safety of a vehicle to be a significant factor in their decision making process. We envision a future where one of the key criteria in buying a house or building will be its safety from natural hazards – how well was the building designed and constructed and is it certified to meet a certain code level of performance.
- ◆ Achieving this vision will ultimately require a fundamental change in public behavior. This change will need to start with programs that address and encourage mitigation at the local level, and do so before disaster strikes. This is already beginning to happen with FEMA's Project Impact initiative, where we are beginning to see a fundamental change in communities where pre-disaster mitigation is supported by both the public and private entities. This public-private partnership has enormous potential to increase the demand and visibility of mitigation and ultimately work to reduce future losses. We strongly believe that a pre-disaster mitigation program will ultimately be a far more efficient use of taxpayer money than waiting until after the disaster has occurred.

The NEHRP has long had many resources available that are now being effectively used within Project Impact. Many of our FEMA Regional earthquake staff already had local and state experience and were able to quickly work with many of the Project Impact communities. Indeed, some of the most effective Project Impact communities have been those where earthquake is the primary hazard, such as Seattle and Oakland. A list of specific examples of some of the truly ground-breaking projects that have been undertaken within these communities would include:

- Oakland established a grant/low interest loan program for residential structures to fund disaster reduction activities. The program and application process were specifically designed to be reproducible for other Project Impact communities;
- Oakland has completed the first phase of a program using volunteer workers to identify hazards and perform non-structural fire and earthquake mitigation on 154 low income apartments operated by the Oakland Housing Authority;
- Seattle has initiated a "Project Impact Home Retrofit Program" to assist homeowners in seismically upgrading their dwellings. The program includes training classes, professional guidance, display of materials and space for training classes at a local

hardware chain, publication of training materials funded by an insurance company and a website by the University of Washington for further information.

- To help provide funding for the Seattle program, Washington Mutual Bank and Seafirst Bank have announced a low interest earthquake retrofitting loan program. The City has also instituted an expedited building permit process for loan applicants.
- Seattle has also initiated a seismic retrofitting program to address non-structural hazards in schools and a landslide mapping program with the USGS.

Our hope is that these pre-disaster activities will serve both as the catalyst and the foundation for natural hazards risk reduction activities by public and private sector interests. However, this encouragement is taking place in the context of diminishing Federal budgets and will require a careful review of the best use of the resources of all of the parties - public and private - in the process. This means that we need to emphasize more consistently those aspects of our program that seek to understand the mechanisms and processes that offer the greatest promise of helping communities and individuals acknowledge their risk, accept responsibility for reducing that risk, and take appropriate actions to become more disaster resistant. It is our intention, using the strategic planning process and involving all interested parties, to focus more heavily on this facet of our responsibilities.

As this Committee is well aware, in addition to the efforts of the federal and state and local governments, advances in earthquake risk reduction in the United States are also owed to the efforts of professionals, academics and others in the private sector. I would be remiss if I did not acknowledge our debt of gratitude to those who have worked so ably over the years contributing to the advances we have achieved. The graphic examples of Northridge and Kobe have spurred interest by businesses to reduce their seismic vulnerability and that of the communities in which they are located and upon which they depend for their human resources. This interest is sustained by our ability to characterize and display the risk with increasing precision, and by our ability to provide solutions or alternatives that may be applied to the issues at hand. Organizations such as the Disaster Recovery Business Alliance and the Cascadia Regional Earthquake Workgroup are actively engaging businesses in dialog with one another and with their communities on what might be done, working together, to address earthquake-related issues.

In closing, I express my appreciation for the consistent support and counsel of this Committee and look forward to our continuing association in addressing the challenges before us.